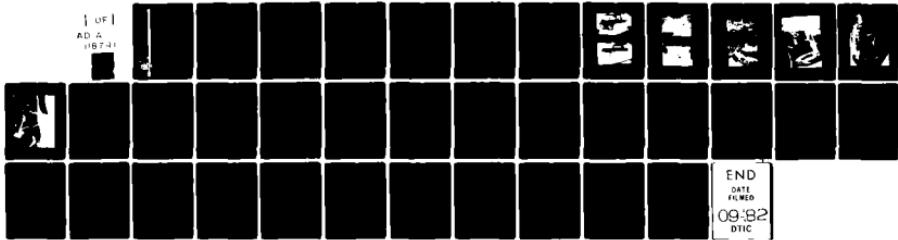


AD-A118 741

ARMY MOBILITY EQUIPMENT RESEARCH AND DEVELOPMENT COMM--ETC F/G 21/3
VERIFICATION TEST OF THE BATTRONIC TRUCK VOLTA ELECTRIC PICKUP.(U)
APR 82 E J DOWGIALLO, I R SNELLINGS EC-77-A-31-1042
UNCLASSIFIED MERADCOM-2357 NL

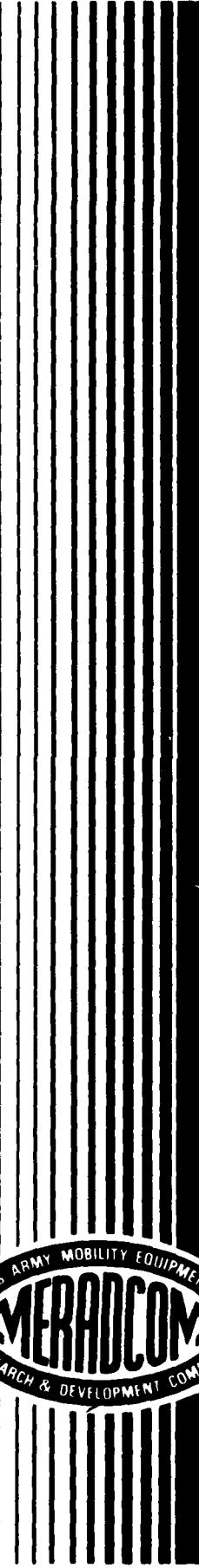
1 OF
AD A
108741



END
DATE
FILED
09-82
DTIC

DMG FILE COPY

AD A118741



(12)

AD A118741

Report 2357

VERIFICATION TEST OF THE BATTRONIC TRUCK

VOLTA ELECTRIC PICKUP

by

Edward J. Dowgiallo, Jr.
Ivan R. Snellings
and
Robert D. Chapman

April 1982

1100 11 1982

Approved for public release; distribution unlimited.

U.S. ARMY MOBILITY EQUIPMENT
RESEARCH AND DEVELOPMENT COMMAND
FORT BELVOIR, VIRGINIA

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER 2357	2. GOVT ACCESSION NO. AD-A118741	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) VERIFICATION TEST OF THE BATTRONIC TRUCK VOLTA ELECTRIC PICKUP		5. TYPE OF REPORT & PERIOD COVERED Verification Test July 1980 to January 1981
7. AUTHOR(s) Edward J. Dowgiallo, Jr. Ivan R. Snellings Robert D. Chapman		6. PERFORMING ORG. REPORT NUMBER CONS/0421
9. PERFORMING ORGANIZATION NAME AND ADDRESS Electrochemical Div; Electric Power Lab; DRDME-EC US Army Mobility Equipment Research and Development Command; Fort Belvoir, Virginia 22060		8. CONTRACT OR GRANT NUMBER(s) EC-77-A-31-1042
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Mobility Equipment Research and Development Command; ATTN: DRDME-EC; Fort Belvoir, Virginia 22060		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) Prepared for DOE: Electric & Hybrid Highway Vehicle Systems, Program Division of Transportation Energy Conservation		12. REPORT DATE April 1982
		13. NUMBER OF PAGES 40
		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited.		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Electric Vehicle Propulsion Batteries Controller Charger		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The Volta Pickup is an electric 1/2-ton truck manufactured by the Battronic Truck Co. It was tested by MERADCOM at Fort Belvoir, Virginia as part of a Department of Energy project to verify conformity to performance standards of electric vehicles. The verification test results are presented in this report. The Volta Pickup is powered by 24 6-V lead-acid batteries, has a 38 hp series wound d.c. motor, SCR chopper controller, regenerative braking, and a 2-speed Helical gear transmission.		

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

PREFACE

This report was prepared to document work sponsored by the United States Government. Neither the United States nor its agents the United States Army, nor any Federal employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, expressed or implied, or assumes any legal liability to responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights.

The views, opinions, and/or findings contained in this report are those of the authors and should not be construed as an official Department of the Army position, policy, or decision, unless so designated by other documentation.

This vehicle was tested to determine its conformity to the Department of Energy (DOE) "Performance Standards for Demonstrations." The results reported herein show the nominal capability of the vehicle when the standards are exceeded and the maximum capability of the vehicle when it failed to meet the standards. The vehicle may exceed the performance reported in actual use. It may also have safety features and amenities not required by DOE Standards.

Mr. Michael E. Johnson, P.E., of V.S.E. Corporation, was responsible for aspects of calibration of the signal conditioning circuits and recording instruments and data tabulations, plotting, and preparation of this report.

Messers James A. Queen and Calvin T. Bushrod of the Environmental and Field Division, Product Assurance and Testing Directorate, MERADCOM, assisted in data collection and vehicle operation.



CONTENTS

Section	Title	Page
	PREFACE	iii
	ILLUSTRATIONS	v
I	SUMMARY	1
II	INTRODUCTION	1
III	OBJECTIVES	1
IV	DESCRIPTION OF TEST VEHICLE	2
V	TEST RESULTS	2
VI	CHRONOLOGY OF VEHICLE FAILURES AND CORRECTIVE ACTION	11
	APPENDICES	
	A. VEHICLE DATA SUMMARY SHEET	12
	B. PERFORMANCE STANDARDS FOR DEMONSTRATIONS, FEDERAL REGISTER MAY 1978	17
	C. ELECTRIC AND HYBRID VEHICLE VERIFICATION PROCEDURES	20

ILLUSTRATIONS

Figure	Title	Page
1	Front of Volta Pickup	3
2	Rear of Volta Pickup	3
3	Battery Compartment (open)	4
4	Battery Compartment (tray extended)	4
5	Controller by Cableform	5
6	Instrument Panel	5
7	Battery Compartment Ventilator Fan	6
8	On-board Battery Charger Behind Passenger Seat	7
9	On-board Battery Charger Behind Driver's Seat	8

VERIFICATION TEST OF THE BATTRONIC TRUCK VOLTA ELECTRIC PICKUP

I. SUMMARY

The Volta pickup truck is an electric, multipurpose utility vehicle manufactured by the Battronic Truck Corporation of Boyertown, Pennsylvania. The vehicle was tested from July 1980 to September 1981. Complete test results are contained in Section V of this report. Part of the verification test results are summarized below:

Acceleration: 0-50 km/h (31.1 mi/h) in 10.0 s.

Range: SAE J227a "B" cycle on level (\pm 1-percent grade) terrain yielded 55.2 km (34.3 mi) and 162 cycles.

Forward Speed Capability: The vehicle maintained 70 km/h (43.5 mi/h) for more than 5 min on the level (\pm 1-percent) portion of the MERADCOM test track.

Gradeability at Speed: At 25 km/h (15.5 mi/h) the vehicle can traverse a 13-percent grade based on calculations from acceleration tests.

Gradeability Limit: Calculations based on drawbar-pull tests indicate a 11.5-percent forward and 12.4-percent reverse gradeability for at least 20 s.

II. INTRODUCTION

The Volta electric pickup was operated to determine conformity to the DOE "Performance Standards for Demonstrations," published in the Federal Register, Tuesday, 30 May 1978, Part V. The results of that testing, as performed by MERADCOM, and other descriptive data concerning the vehicle are presented in this report.

III. OBJECTIVES

The objectives of this test were to examine the Battronic Volta for suitability of those aspects of vehicle and component operating characteristics as outlined in the DOE "Performance Standards for Demonstrations" and the "Electric and Hybrid Vehicle Verification Procedures" (Appendices B and C).

IV. DESCRIPTION OF TEST VEHICLE

The Volta electric pickup truck is manufactured by the Battronic Truck Corporation, 3rd and Walnut Streets, Boyertown, Pennsylvania. It is a commercial vehicle designed for use primarily as a delivery conveyance (Figures 1 and 2). The Volta is 4.13 m (13.6 ft) long, 1.9 m (6.3 ft) wide, and 1.9 m (6.3 ft) high and has a 2.5-m (8.2-ft) wheelbase. It has curb weight of 2200 kg (4850 lb) and carries a 453.6-kg (1000-lb) payload including passenger and driver. The vehicle is powered by 24 6-volt lead-acid batteries connected in series. The batteries are Exide, model EV106 rated at 132.5 Ah (106 min @ 75-A rate). They are located in two compartments beneath the bed of the vehicle in the midsection of the truck (Figures 3 and 4). The Cableform, SCR chopper controller and the 38-hp series wound General Electric d.c. motor are located in the front of the vehicle (Figure 5).

The Volta is equipped with a 2-speed manually shifted transmission, leaf springs front and rear, and Bendix hydraulic drum brakes on all four wheels. The tires are Firestone, steel-belted radials, inflated to 241.3 kPa (35 lb/in²). The Volta comes with standard equipment such as windshield wipers, heaters, speedometer, bucket seats, state-of-charge meter, ammeter, voltmeter (Figure 6), and battery-compartment ventilator fan (Figure 7). The heater is a gasoline-fueled unit manufactured by Hunter and rated at 20,000 Btu/h. The chargers used are located behind the seats in the cab of the vehicle. These chargers, manufactured by Lester, work off either 110-V or 220-V a.c. with a maximum current rating of 30 A. They are equipped with automatic turnoff when the batteries are fully charged (Figures 8 and 9).

V. TEST RESULTS

The results of the verification tests performed at MERADCOM during 8 July 1980 to January 1981 follow (paragraphs are referenced to the DOE "Performance Standards for Demonstrations" criteria):

- 475.11 (a) Acceleration: 0-50 km/h (31.1 mi/h) in 10 s.
- (b) Gradeability at Speed: At 25 km/h (15.5 mi/h) the vehicle can traverse a 13-percent grade based on calculations from acceleration tests.
- (c) Gradeability Limit: Calculations based on drawbar-pull test indicate a 11.5-percent forward and a 12.4-percent reverse gradeability for at least 20 s.
- (d) Forward Speed Capability: The vehicle maintained 70 km/h (43.5 mi/h) for more than 5 min on the level (\pm 1-percent grade) portion of the MERADCOM Test Track.

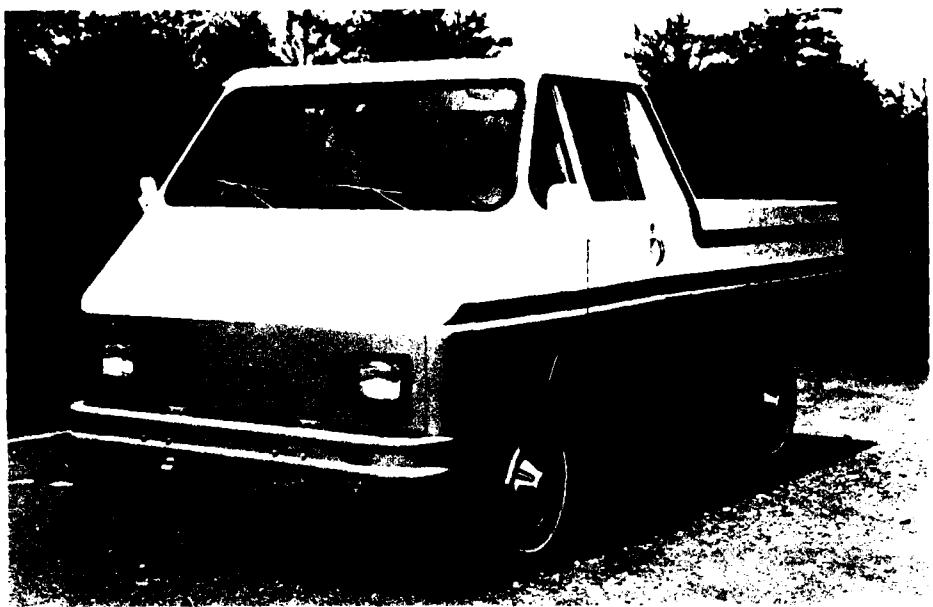


Figure 1. Front Volta pickup.

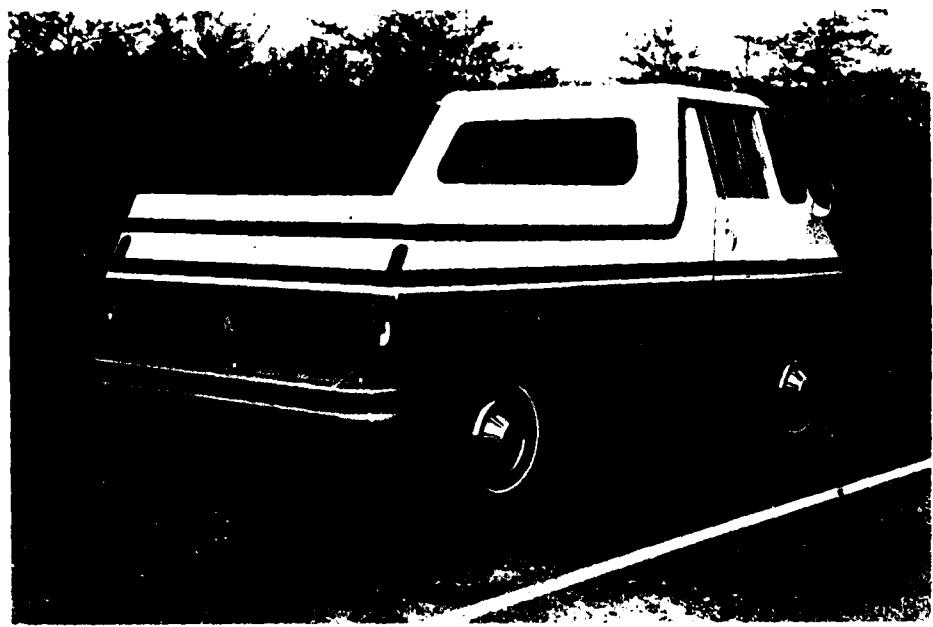


Figure 2. Rear Volta pickup.



Figure 3. Battery compartment (open).



Figure 4. Battery compartment (tray extended).

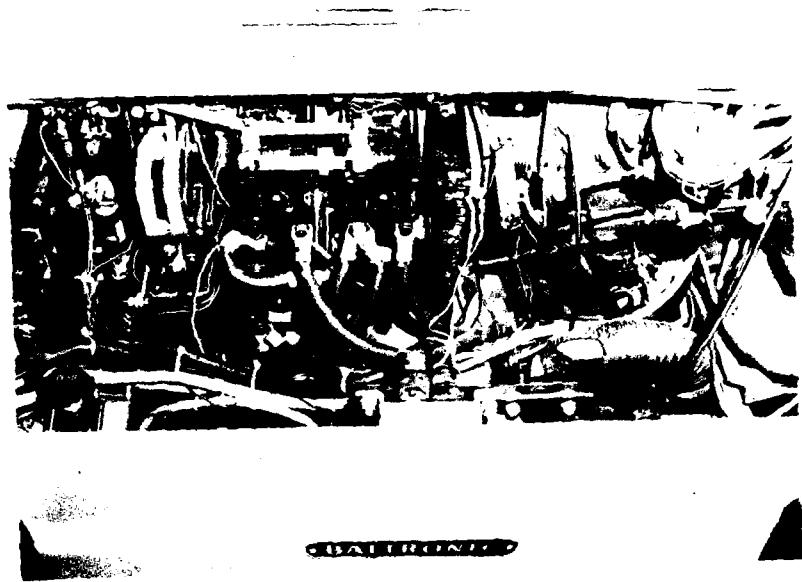


Figure 5. Controller by Cableform.

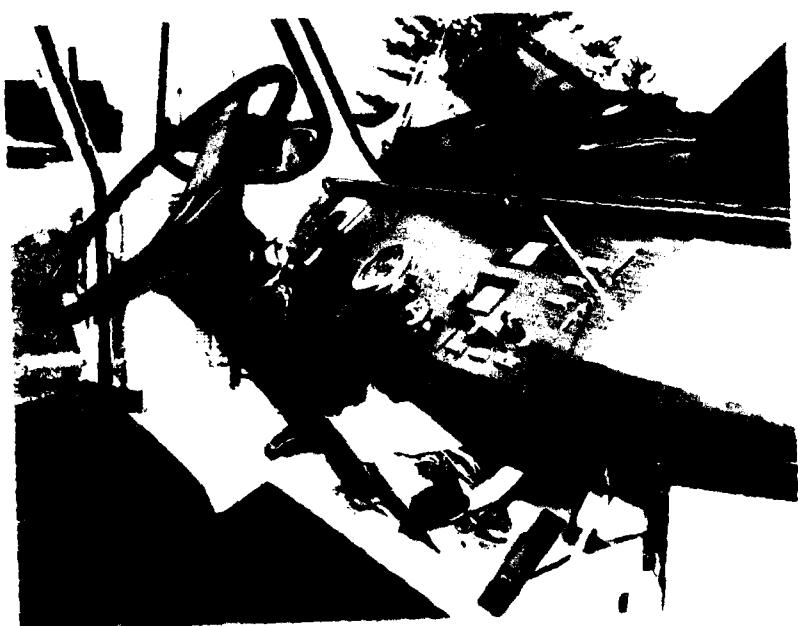


Figure 6. Instrument panel.



Figure 7. Battery compartment ventilator fan.

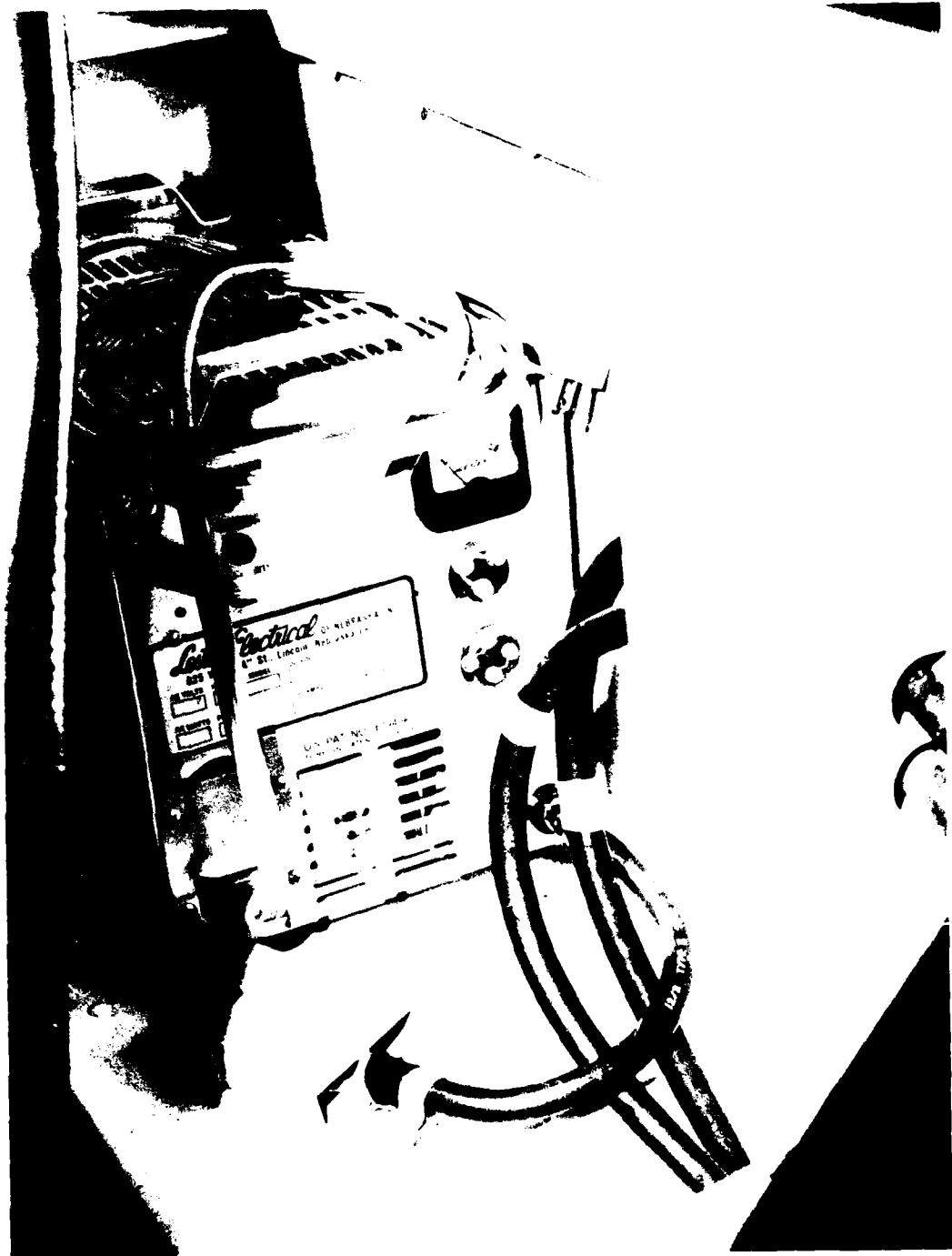


Figure 8. On-board charger behind passenger seat.



Figure 9. On-board charger behind driver's seat.

(e) Range: SAE J227a "B" cycle on level (\pm 1-percent) terrain yielded 55.2 km (34.3 mi) and 162 cycles.

(f) Battery Recharge Time: After 80-percent DOD* the vehicle was recharged with on-board chargers (220-V, 30-A) for 10 h. After recharge the vehicle operated for 54.5 km (33.9 mi) to an SAE J227a cycle "B" regime.**

(g) Recharge Control: Tapering voltage comparator.

(h) Energy Consumption: The only nonelectric energy used by test vehicle is the gasoline-fueled heater (see (l)).

(i) Battery:

1. Warranty: 12 months prorated by battery manufacturer (1 year umbrella warranty by vehicle manufacturer).

2. Type: Exide, EV106.

3. Capacity: 132.5 Ah (106 min a 75-A rate)

4. Voltage: 144 V (24 6-V modules connected in series).

(j) State-of-Charge Meter: The vehicle is equipped with a color-coded dial indicator which indicates the remaining capacity of the batteries based on battery voltage.

(k) Odometer: The vehicle is not equipped with an odometer.

(l) Passenger Comfort Heater: The vehicle is equipped with a gasoline-fired heater rated at 20,000 Btu/h.

(m) Documentation: Operations manual, electrical schematics, and parts list were supplied with the vehicle.

(n) Emissions: Did not evaluate.

* 80-percent DOD was reached by driving vehicle for 80 percent of required distance while operating to an SAE J227a cycle "B" regime.

** Exide XPV-23-3 batteries were used for this test only. All other tests had been completed with Exide EV106 batteries representing an older technology that will not be used in future vehicles.

(o) Safety, etc.: The Department of Transportation (DOT) is performing these evaluations; however, MERADCOM performed the following limited checks for design intent:

(1) Electrical Isolation: The electrical propulsion circuit is completely isolated from the vehicle chassis.

(2) Safety Standards 208 and 301: DOT will check compliance.

(3) Battery Caps: Standard golf-cart industry type; flame barrier characteristics were not tested.

(4) Ventilation of Battery Compartments: The battery compartments are vented by means of a 375-ft³/min fan which forces fresh air into and around the battery area when charging. This fan is sufficient to change the air in the compartments 24.7 times per minute. While the vehicle is operating, the compartments are exposed to outside air.

(5) Battery Emergency Disconnect: This consists of a manually activated, mechanically linked disconnect switch operated from the normal operator position.

(6) Parked Temperature Effect: The vehicle was parked for 8 h at each of the temperatures -25° C and +50° C. Subsequent operation at each of those temperatures revealed no apparent damage to the vehicle or hazard to personnel.

(7) Braking Straight Line Dry and Brake Operability Without Electric Power:

STOPPING DISTANCE REQUIREMENTS

The force applied to brake control shall not be less than 66.9 N (15 lb) and not more than 669 N (150 lb) FMVSS.

Vehicle Speed (km/h)	Maximum Distance (m)*
48.3 km/h (30 mi/h)	21.0 m (69 ft)
64.6 km/h (40 mi/h)	43.9 m (144 ft)
80.4 km/h (50 mi/h)	68.6 m (225 ft)

*Vehicles other than passenger cars with gross vehicle weight of 4540 kg (10,000 lb) or less.

The vehicle displayed the following characteristics with brakes dry:

<u>Vehicle Speed</u>	<u>Distance</u>	<u>Pedal Pressure</u>
48.3 km/h (30 mi/h)	18.3 m (60 ft)	615.5 N (138 lb)
64.4 km/h (40 mi/h)	33.5 m (110 ft)	628.9 N (141 lb)
80.4 km/h (50 mi/h)	50.4 m (165.5 ft)	624.4 N (140 lb)

Brakes are operable without electric power.

VI. CHRONOLOGY OF VEHICLE FAILURES AND CORRECTIVE ACTION

The following were corrected and the vehicle was tested to verification performance requirements:

<u>Date</u>	<u>Failure/Problem</u>	<u>Corrective Action</u>
July 1980	Hi-Temperature Lite on drive motor indicating motor overheating.	Replacement of motor cooling fan with larger unit by Battronic personnel.
July 1980	Regenerative braking working intermittently.	Adjustment of accelerator linkage by Battronic personnel.
July 1980	One of the on-board chargers not functioning properly.	Returned charger to manufacturer (Lester) for repair.

APPENDIX A

VEHICLE DATA SUMMARY SHEET

1. VEHICLE MANUFACTURER:

Batronic Truck
Third & Walnut Street
Boyertown, Pennsylvania 19512

2. VEHICLE DESCRIPTION:

Name: Volta
Availability: 4 mo
Model: Pickup Truck
Price: \$21,500 (Feb 81)

3. VEHICLE WEIGHT:

Curb Wt: 2200 kg (4850 lb)
Driver Wt: 79 kg (175 lb)
Gross Wt: 2654 kg (5850 lb)
Payload Wt: 453.6 kg (1000 lb)

4. VEHICLE SIZE:

Wheelbase: 2.5 m (98 in.)
Headroom: 0.9 m (37 in.)
Length: 4.1 m (163 in.)
Width: 1.9 m (76 in.)
Legroom 0.96 m (38 in.)

5. AUXILIARIES AND OPTIONS:

No. Lights: 11
a. Head
b. Parking
c. Signal
d. Dome

- e. Tail
- f. Tag
- g. Backup
- h. Stop
- i. Emergency
- j. Dash
- k. Running

Function: Illumination

Windshield Wipers: Yes

Windshield Washers: Yes

Defroster: Yes

Heater: Yes

Radio: No

Fuel Gage: Yes

Ammeter: Yes

Tachometer: No

Speedometer: Yes

Odometer: Yes

No. Mirrors: 3

Power Steering: No

Power Brakes: No

Transmission Type: Manual gearshift

6. PROPULSION BATTERIES:

Type: Lead-Acid

Manufacturer: EXIDE

No. of Modules: 24

Model: EV106

No. Cells: 72

Battery Voltage: 144 V

Ah Capacity: 132.5

Battery Size: H .3 m, W .18 m, L .3 m
(H 10 in. x W 7 in. x L 10 in.)

Battery Wt: 30 kg (66 lb)

Battery Age: N/A

Battery Rate: 75 A 106 min

Battery Cycles: 750 cycles

7. AUXILIARY BATTERY:

Type: Lead-Acid
Manufacturer: Titan
No. Cells: 6
Battery Voltage: 12 V
Ah Capacity: 96
Battery Size: .3 m x .18 m x .21 m
(12 in. L x 7 in. W x 8½ in. H)
Battery Rate: 2 h
Battery Wt: 28 kg (62 lb)

8. CONTROLLER:

Type: SCR
Manufacturer: Cableform
Voltage Rating: 144 V
Current Rating: 600 A
Size: .3 m x .18 m x .3 m
(12 in. x 7 in. x 12 in.)
Weight: 59 kg (130 lb)

9. PROPULSION MOTOR:

Type: 38-hp Series Wound
Manufacturer: General Electric
Insulation Class: F
Voltage Rating: 128 V
Current Rating: 220 A
HP Rating: 38 hp
Max 5-Min Rating: 300-percent Overload
Size: .61 m L .28 m Dia.
(24 in. L x 11 in. Dia.)
Weight: 116 kg (255 lb)
Rated Speed: 3400 r/min
Max Speed: 6000 r/min

10. BODY:

Type: Volta
Manufacturer: Batronic
No. Doors: 2
Type: Side-hinge
No. Windows: 4
Type: Side, Slide; Front and Back, Fixed
No. Seats: 2
Type: Bucket
Cargo Volume: 2.4 m³ (85 ft³)
Cargo Dimensions: 1.9 m x 1.8 m x .66 m
(76 in. L x 73 in. W x 26 in. H)

11. CHASSIS:

Type Frame: Channel Chassis
Manufacturer: Batronic
Type Material: Pressed Steel
Modifications: None
Type Springs: Leaf
Type Shocks: Hydraulic
Axe Type Front: Tube
Axe Type Rear: Semi-floating
Axe Manufacturer: Dana
Drive Line Ratio: 4.55:1
Type Brakes Front: Drum
Type Brakes Rear: Drum
Regenerative Brakes: Yes
Tire Type: Radial
Manufacturer: Firestone
Size: .38 m (15 in.)
Pressure: 241.3 KPa (35 lb/in.²)
Rolling Radius: .34 m (13.66 in.)

12. BATTERY CHARGER (2 ea):

Type: Ferro Resonant
Manufacturer: Lester
On or Off Board: On
Input Voltage: 110 or 220 V
Peak Current: 15 or 30 A
Recharge Timer: None
Size: .27 m x .38 m x .23 m
(10.5 in. H x 15 in. L x 9 in. W)
Weight: 16 kg (35 lb)
Automatic Turn Off: Yes

APPENDIX B

PERFORMANCE STANDARDS FOR DEMONSTRATIONS

**FEDERAL REGISTER
TUESDAY, 30 MAY 1978
PART V, SUBPART B**

475.11 Minimum levels of performance for commercial vehicles.

The following minimum levels of performance are required with respect to any commercial vehicles purchased or leased pursuant to section 7 (c) of the Act.

(a) Acceleration. The time required to accelerate from rest to 50 km/h shall not exceed 15 s.

(b) Gradeability at speed. The grade which can be traversed up at 25 km/h shall be at least 10 percent.

(c) Gradeability limit. The grade on which the vehicle can start and climb for 20 s either backward or forward shall be no less than 20 percent.

(d) Forward speed capability. The speed which can be maintained for 5 min shall be 70 km/h.

(e) Range. The distance which the vehicle can be operated with vital accessories on or equivalent shall be:

(1) For an electric vehicle, at least 50 km on the SAE J227a/B cycle, and

(2) For a hybrid vehicle, at least 200 km on the SAE J227a/B cycle.

(f) Battery recharge time. The vehicle shall be capable of satisfying the range requirement of 475.11 (e) above, after being recharged for no more than 10 h. At the start of this recharge the vehicle shall have 80 percent discharged batteries as specified by the vehicle test conditions and procedures of 475.3.

(g) Recharge control. The vehicle shall have a recharge control which is adequate to meet the requirements of energy, life, and safety as such requirements are stated by these performance standards.

(h) Energy consumption:

(1) For an electric vehicle, the maximum amount of nonelectrical energy consumed shall be that used for operation of the accessories only.

(2) For a hybrid vehicle, nonelectrical energy consumed shall not exceed 9.8 kj/kmkg of cargo and shall also not exceed 75 percent of total energy consumed for propulsion and vital accessories, based on being fully loaded on a driving schedule of 100 km on SAE J227a/B cycle, the cargo not including the operator, and with vital accessories on.

(i) Battery life:

(1) The vehicle shall be capable of at least 75 percent of the range specified in 475.11 (e) after 12 mo or 15,000 km of normal use, whichever occurs first.

(2) The vehicle shall be capable of 100 percent of the acceleration and gradeability specified in 475.11 (a), (b), and (c), for all test conditions and procedures specified by 475.3 for 12 mo or 15,000 km of normal use, whichever occurs first.

(3) The batteries shall, if necessary, be repaired or replaced by the vehicle manufacturer at no cost to the user of the vehicle in order to meet requirements of (1) and (2) of 475.11 (i).

(j) State-of-charge meter. The vehicle shall have a state-of-charge meter for the propulsion battery system or other means of providing an indication of remaining range.

(k) Odometer. The vehicle shall have an odometer.

(l) Passenger comfort heater. The vehicle shall have a passenger comfort heater available as an option.

(m) Documentation. Adequate user manuals, maintenance (service) manuals, and parts lists shall be provided.

(n) Emissions. The vehicle shall comply with all applicable Federal emission regulations for motor vehicles.

(o) Safety, crashworthiness, damageability, crash avoidance, and hazards:

(1) The vehicle shall comply with all applicable Federal regulations for motor vehicles concerning safety, crashworthiness, damageability, crash avoidance, and hazards, unless a waiver or modification is obtained from the Department of Transportation.

(2) Until the Department of Transportation issues regulations which cover the same subjects, the vehicles shall also have the following performance characteristics:

(i) The electric propulsion circuit shall be electrically isolated from other conductive portions of the vehicle.

(ii) The vehicle shall be capable of undergoing the test procedure of Federal Motor Vehicle Safety Standards 208 and 301 with all battery materials remaining outside the passenger compartment.

(iii) Vehicles with battery caps or battery vents shall have flame barrier provisions to inhibit battery explosions.

(iv) Ventilation shall be adequate within the battery compartment to maintain the concentration of hydrogen below 4 percent by volume during vehicle operation (including charging and maintenance).

(v) The vehicle shall have a device which provides for the positive disconnection of the battery and which is operable from the normal operator position.

(vi) The vehicle shall be capable of being parked for up to 8 h in temperatures of -25° C to 50° C and subsequently operated at any temperature within this temperature range without damage to the vehicle or to persons.

APPENDIX C

ELECTRIC AND HYBRID VEHICLE VERIFICATION PROCEDURES

BACKGROUND

DOE is required by Public Law 94-413 to issue performance standards for vehicles used in the Electric and Hybrid Vehicle (EHV) Market Demonstration. On 30 May 1978, DOE published a final rule in the Federal Register (Vol. 43, No. 104) promulgating the first Performance Standards. This rule was effective on 3 July 1978 and prescribed minimum performance standards for electric and hybrid vehicles to be purchased or leased for the first phase of a demonstration program under the Electric and Hybrid Research and Development Act of 1976. Performance Standards are updated from time to time and the current rule was published in the Federal Register on 12 February 1980 (Vol. 45, No. 30).

Manufacturers who certify that their vehicles meet the latest requirements of the DOE Performance Standards may offer those vehicles for the DOE Market Demonstration Program. DOE reserves the right to verify, by independent test, the manufacturer's self-certification. The test procedures used for DOE performance tests are based on SAE Test Procedures J227a. Safety inspection and testing services are provided by the Department of Transportation/National Highway and Traffic Safety Administration (DOT/NHTSA) through an interagency agreement. Performance testing is performed by the US Army Mobility Equipment Research and Development Command through an interagency agreement. During verification testing vehicle component or subsystem failures will be immediately brought to the attention of the manufacturer. Repeated or multiple component or subsystem failures experienced during test are grounds for invalidating the self-certification of the vehicle for purpose of the DOE Market Demonstration Program.

CERTIFICATION PROCESS

A manufacturer can certify an existing vehicle as meeting the DOE Standards (which include applicable NHTSA safety standards by reference) at any time by submitting a letter of certification and providing the required data on the vehicle to the Department of Energy Director of Electric and Hybrid Vehicles Division or his designee.

VERIFICATION PROCESS

Should DOE elect to verify the certification, arrangements will be made with the manufacturer for delivery of the vehicle to a DOE-specified site for testing. (Details of scheduling priorities are described in the following section). Several basic types of tests may be involved:

- DOE-Sponsored Performance Tests by the US Army MERADCOM.
- DOE-Sponsored Safety Inspection by DOT/NHTSA
- DOE-Sponsored Safety Compliance Testing by the Research Division of DOT/NHTSA.
- DOT/NHTSA Safety Compliance Test (Independent of DOE).

One important principle followed by DOE during testing is to allow the Facility Manager to work with manufacturers to overcome the normal problems that occur during inspection and testing. To ensure impartial treatment of manufacturers during the test sequence, limits have been set for the Test Facility Manager concerning how many vehicle component or subsystem failures can be allowed before certification is invalidated. DOE will objectively evaluate the impact of all failures during the testing phase so that vehicles are not unfairly penalized for minor and easily correctable failures. The Test Facility Manager, however, has an obligation to conduct the testing thoroughly and to adhere to a tight schedule.

Manufacturers may be notified from time to time by the Test Facility Manager of potential and actual problems. When these problems do not involve components or subsystem failures, where failure is defined as a vehicle being below the required standard, such notification would not necessarily invalidate the certification.

TEST FACILITY SCHEDULING GUIDELINES

Vehicles will be scheduled for testing by the Test Facility Manager on a first-come, first-served basis, with certain exceptions as noted below. Scheduling is dependent upon the ability of the manufacturer to provide a vehicle for testing. The Test Facility Manager will request the manufacturer to provide a certified vehicle for testing within 60 days from the date of the request. If a vehicle is not received at the Test Facility within the 60-day period, the self-certification will be returned and the vehicle will be removed from the self-certification list.

The primary function of certification testing is to ensure that vehicles available to the Market Demonstration Program fully satisfy the applicable DOE Performance Standards. For this reason, it is necessary to establish a set of priority testing categories for vehicles selected or being considered for selection by demonstration site operators. The categories are listed below in decreasing order of priority for testing:

1. Certified vehicles which have not been verified but have been purchased by and delivered to site operators.
2. Certified vehicles purchased by but not delivered to site operators for demonstration.
3. Certified vehicles that have been modified subsequent to verification testing and have been delivered to site operators.* On request by DOE, the manufacturer will furnish DOE with technical information about each modification in sufficient detail to determine if reverification tests are needed.
4. Certified vehicles that are being considered for purchase by a site operator.
5. Certified vehicles that are available for test but are not under consideration by a site operator.

Vehicle test schedules are sensitive to the requirements of the Market Demonstration Program, and rescheduling by the Test Facility Manager may be required to meet changing needs. Vehicles delivered late or taken out of test because of operational failure may be rescheduled on a lower priority basis by the Test Facility Manager with approval of the DOE Test Manager. On-site rectification of a vehicle problem by the manufacturer within a 5-working-day period described below may avoid the necessity for rescheduling.

VEHICLE MODIFICATION/REPAIR GUIDELINES

The guidelines provided in this section are for use by the Test Facility Manager. Exceptions to these guidelines require the approval of the Director of the DOE Electric and Hybrid Vehicle Division or his designee. The intent of these guidelines is to facilitate the establishment of a clear basis for validating or invalidating a manufacturer self-certification. Subsystem failures may raise questions as to the relevance of the results of the validation testing. It is also important that the test facilities not be used for development and test engineering. Vehicles that experience repeated failures of the same component or subsystems must be upgraded before verification testing can be rescheduled. Rescheduling will

* The manufacturer is responsible for notifying the DOE director of the Electric and Hybrid Vehicle Division or his designee of all modifications to the verified production configuration.

be contingent on the submission and acceptance of evidence, obtained by the manufacturer through testing, that the cause of failure has been corrected. The Test Facility Manager will determine when significant repairs should be and have been made.

VEHICLE MODIFICATIONS/REPAIRS ON OR NEAR THE TEST FACILITY

A. Only those modifications or repairs that can be completed within 5 working days by the manufacturer or his designee will be allowed. If the repairs cannot be completed within this period, the vehicle must be removed from the test facility unless DOE programmatic requirements dictate that it is in the best interest of the Government that a waiver be granted by the Director of the Electric and Hybrid Vehicles Division or his designee.

B. All failures requiring repair, whether significant or insignificant, will be recorded by the Test Facility Manager or his designee. For all repairs the manufacturer must submit (to the Test Facility Manager) written explanation of the failure modes and the corrective action taken within 15 days after completion of corrective action. Failed components or subsystems must be replaced by an identical part except in those cases where the component or subsystem design is inadequate. In the latter case, the manufacturer may substitute a readily available component or system when the manufacturer can provide assurance of improved reliability and performance.

C. Three on-site repairs to correct a significant powertrain failure are allowed. A fourth failure will invalidate the vehicle certification, and the Facility Manager will order the vehicle to be returned to the manufacturer unless DOE programmatic requirements dictate that a waiver be granted by the Director of the Electric and Hybrid Vehicles Division or his designee.

D. Subject to overriding priority considerations, testing will be resumed as soon as repairs are completed.

VEHICLES RETURNED TO THE MANUFACTURER BECAUSE OF FAILURE IN TEST

A. A letter invalidating the certification will be issued to the manufacturer and DOE will notify site operators of the invalidation. A report including the vehicle failures will be provided by DOE to members of the public requesting such a report. Vehicles that are part of the Market Demonstration Program (based on the manufacturer's self-certification) which fail the verifications tests will have their certifications invalidated until successful correction of the defects is completed. Future funding to site operators for the invalidated vehicle model will be suspended until corrections are completed.

B. A one-time voluntary withdrawal of a vehicle from test by a manufacturer to correct problems is allowed for a period not to exceed 60 days. The vehicle will be rescheduled for testing based on priorities at the time of resubmittal. No action will be taken to invalidate the certification during the voluntary withdrawal period unless there is a clear case of user safety involved or the manufacturer fails to offer the vehicle for test after 60 days.

C. Before a vehicle can be resubmitted for testing, the manufacturer must provide to the Director of the Electric and Hybrid Vehicles Division, or his designee, appropriate evidence that modifications and/or repairs have been made. The manufacturer must also provide substantiating test data to show that the vehicle can meet all DOE Performance Standards.

D. Repaired vehicles returned by the manufacturer may be required to undergo the complete series of verification tests regardless of the portion of testing completed prior to invalidation of certification. The Test Facility Manager with the approval of DOE will determine the necessity for such retesting.

GROUNDS FOR INVALIDATING CERTIFICATION

1. A vehicle will be returned to the manufacturer after four significant powertrain failures or a single powertrain failure that cannot be corrected, and its certification will be invalidated.

2. A vehicle that fails to meet applicable DOE Performance Standards will have its certification invalidated. (The standards include documentation and warranty provisions.)

3. A vehicle that fails to comply with applicable DOT/NHTSA Safety Regulations will have its certification invalidated.

4. If a manufacturer fails to commit to and follow a reasonable schedule (defined in the following section) to provide a vehicle for testing when requested by DOE, the vehicle will have its certification invalidated.

SUMMARY OF RESPONSIBILITY OF MANUFACTURERS

Manufacturers must self-certify their production vehicles to participate in the DOE Market Demonstration Program. They must also commit to a reasonable schedule to provide a vehicle for verification testing upon request from the DOE designated Test Facility Manager. If this delivery cannot be made within 60 days after receipt of such a request, the self-certification letter will be returned and the vehicle will be removed from the self-certified list.

Manufacturers must provide required and necessary information to document the vehicle configuration:

- Vehicle Summary Data Sheets,
- Operator's Manual, and
- Service and Maintenance Manual including a parts list.

This information may be in draft form, but it must be complete enough to be useful should any mechanical or electrical difficulty develop in the vehicle.

The manufacturer will notify the Director of the Electric and Hybrid Vehicles Division or his designee of all modifications to previously verified production configurations within 30 days of the sale of such modified vehicles to DOE site operators. If it is requested the manufacturer shall furnish the DOE Test Manager with technical information about each modification in sufficient detail to determine if reverification tests are needed.

For vehicles receiving an invalidation of certification, the manufacturer must provide to the Director of the Electric and Hybrid Vehicles Division appropriate evidence that modifications and/or repairs have been made and must also provide substantiating test data to show that the vehicle can meet all DOE Performance Standards prior to resubmittal of the vehicle for test. Following successful verification testing, vehicles already in DOE site operator fleets must be modified and/or repaired in the same manner as the vehicle successfully tested. A modification and/or repair schedule acceptable to the Director of the Electric and Hybrid Vehicles Division must be developed and followed by the manufacturer as a condition for validation of the manufacturers certification.

DOT NOTIFICATION DOCUMENTATION

DOE will notify manufacturers of actions taken during the verification testing process, including but not limited to:

- Receipt of self-certification.
- Notification of vehicle failure.
- Validation or invalidation of certification.
- Final Test Report.

DISTRIBUTION FOR MERADCOM REPORT 2357

No. Copies	Addressee	No. Copies	Addressee
	Department of Defense		
1	Director, Technical Info Defense Advanced Research Projects Agency 1400 Wilson Blvd Arlington, VA 22209	1	Director US Army Materiel Systems Analysis Agency ATTN: DRXSY-CM Aberdeen Proving Ground, MD 21005
1	Director Defense Nuclear Agency ATTN: TITL Washington, DC 20305	1	Director US Army Materiel Systems Analysis Agency ATTN: DRXSY-MP Aberdeen Proving Ground, MD 21005
12	Defense Technical Info Ctr Cameron Station Alexandria, VA 22314	1	Commander US Army Troop Support and Aviation Materiel Readiness Com ATTN: DRSTS-MES (1) 4300 Goodfellow Blvd St Louis, MO 63120
	Department of the Army		
1	Commander, HQ TRADOC ATTN: ATEN-ME Fort Monroe, VA 23651	1	Director Petrol & Fld Svc Dept US Army Quartermaster School Fort Lee, VA 23801
1	HQDA (DAMA-AOA-M) Washington, DC 20310	1	Commander US Army Electronics Research & Development Command Technical Library Division ATTN: DELSD-L Fort Monmouth, NJ 07703
1	HQDA (DALO-TSM) Washington, DC 20310	1	HQ, 193D Infantry Brigade (Pan) ATTN: AFZU-FE APO Miami 34004
1	Technical Library Chemical Systems Lab Aberdeen Proving Ground, MD 21010	1	Special Forces Detachment, Europe ATTN: PBO APO New York 09050
1	Commander US Army Aberdeen Proving Ground ATTN: STEAP-MT-U (GE Branch) Aberdeen Proving Ground, MD 21005		

No. Copies	Addressee	No. Copies	Addressee
1	Commander Rock Island Arsenal ATTN: SARRI-LPL Rock Island, IL 61201	1	MERADCOM
1	HQDA ODCSLOG DALO-TSE Room 1E588 Pentagon, Washington, DC 20310	1	Commander, DRDME-Z Technical Director, DRDME-ZT Assoc Tech Dir/R&D, DRDME-ZN Assoc Tech Dir/Engrg & Acq, DRDME-ZE Spec Asst/Matl Asmt, DRDME-ZG Spec Asst/Scs & Tech, DRDME-ZK CIRCULATE
1	US Army Engineer School Learning Resources Center Bldg 270 Fort Belvoir, VA 22060	1	Chief, Ctrmine Lab, DRDME-N Chief, Engy & Wtr Res Lab, DRDME-G Chief, CS/CI DRDME-R
1	Commander Headquarters, 39th Engineer Battalion (Cbt) Fort Devens, MA 01433		Chief, Mar & Br Lab, DRDME-M Chief, Mech & Constr Eqpt Lab, DRDME-H
1	Commander and Director USA FESA ATTN: FESA-TS Fort Belvoir, VA 22060		Chief, Ctr Intrus Lab, DRDME-X Chief, Matl Tech Lab, DRDME-V Directorate, Prod A&T Directorate, DRDME-T CIRCULATE
1	Director US Army TRADOC Systems Analysis Activity ATTN: ATAA-SL (Tech Lib) White Sands Missile Range, NM 88002	3	Elec Pwr Lab, DRDME-E Electrochem Div, DRDME-EC Tech Rpts Ofc, DRDME-WP Security Ofc (for liaison officers) DRDME-S
1	HQ, USAEUR & Seventh Army Deputy Chief of Staff, Engineer ATTN: AEAEN-MT-P APO New York 09403	100	Tech Library, DRDME-WC Programs & Anal Dir, DRDME-U Pub Affairs Ofc, DRDME-I Ofc of Chief Counsel, DRDME-L
1	HQ, USAEUR & Seventh Army Deputy Chief of Staff, Operations ATTN: AEAGC-FMD APO New York, 09403	2	Department of the Navy
2	District Engineer ATTN: SWFED-MF FWD Corps of Engineers P.O. 17300 Fort Worth, TX 76102	1	Commander Naval Facilities Engineering Command Department of the Navy ATTN: Code 032-B 062 200 Stovall St Alexandria, VA 22332
		1	US Naval Oceanographic Office Navy Library/NSTL Station Bay St Louis, MS 39522

No. Copies	Addressee	No. Copies	Addressee
1	Library (Code L08A) Civil Engineering Laboratory Naval Construction Battalion Ctr Port Hueneme, CA 93043	1	James Cronin WR-ALC/MMIR-1 Robbins AFB, GA 31098
1	Naval Training Equip Ctr ATTN: Technical Library Orlando, FL 32813	1	Professor Raymond R. Fox School of Engineering & Applied Science George Washington University Washington, DC 20052
2	Naval Weapons Ctr Code 2605 China Lake, CA 93555	1	F. J. Liles 705 Buffalo Drive Arlington, TX 76013
1	Richard Roberts Energy Office Naval Weapons Ctr Code 2605 China Lake, CA 93555	1	C. Grandy Union Electric Co. P.O. Box 149 St Louis, MO 63166
Department of the Air Force			
1	HQ USAF/RDPT ATTN: Mr. Allan Eaffy Washington, DC 20330	1	Marjorie L. McClanahan Chemical Process Unit Materiels Technology Aeronutronic Division Ford Aerospace & Communications Corp Ford Road Newport Beach, CA 92663
1	HQ USAF/LEEU Chief, Utilities Branch Washington, DC 20332	1	Clinton Christianson Argonne National Lab 9700 South Cass Avenue Argonne, IL 60439
1	US Air Force HQ Air Force Engineering & Services Ctr Technical Library FL 7050 Tyndall AFB, FL 32403	1	Ed Morteck Johnson Control Inc Globe Battery Div 5757 N. Green Bay Ave Milwaukee, WI 53201
1	Department of Transportation Library, FOB 10A, M494-6 800 Independence Ave., SW Washington, DC 20591	1	Suite 802 267 Fifth Ave New York, NY 10016
1	Mr. Carl Anderson Energy Technology Demonstration McClellan AFB, CA 95652 SM-ALC/XAE		

No. Copies	Addressee	No. Copies	Addressee
1	Purdue University IIES A. A. Potter Engineering Ctr ATTN: Dr. R. E. Goodson W. Lafayette, IN 47907	10	NASA-Lewis Research Ctr ATTN: H. J. Schwartz MS: JCO-215 21000 Brookpark Rd Cleveland, OH 44135
1	Society of Automotive Engineers, Inc William Toth, Staff Engineer 400 Commonwealth Warrendale, PA 15096	1	Electric Power Research Institute ATTN: Dr. Fritz R. Kalhammer Ralph Ferraro 3412 Hillview Ave P.O. Box 10412 Palo Alto, CA 94304
1	United States Postal Service ATTN: Dick Bowman Office of Fleet Mgmt Delivery Services Dept Washington, DC 20260	1	ESB, Inc. 5 Penn Ctr Plaza Philadelphia, PA 19103
1	United States Postal Service Research & Development Lab ATTN: Lewis J. Gerlach Program Manager 11711 Park Lawn Drive Rockville, MD 20852	1	General Electric Corporate Research & Development ATTN: Gene Rowland Program Manager P.O. Box 8 Schenectady, NY 12301
1	United States Postal Service ATTN: Thomas W. Martin, Manager Vehicle Services Branch Western Region San Bruno, CA 94099	1	General Research Corp ATTN: John Brennand 5383 Holister Ave Santa Barbara, CA 93105
1	Lawrence Livermore Lab ATTN: Douglas Davis-MS-L-216 P.O. Box 808 Livermore, CA 94550	1	General Services Administration Federal Supply Service ATTN: Mel Globerman Washington, DC 20406
1	Los Alamos Scientific Labs Byron McCormick P.O. Box 1663 Los Alamos, NM 87545	1	General Services Administration Federal Supply Service ATTN: R. L. Ulrich Washington, DC 20406
1	NASA-Lewis Research Ctr ATTN: J.S. Fordyce MS: 309-1 21000 Brookpark Rd Cleveland, OH 44135	2	Jet Propulsion Lab ATTN: Keith Hardy Mail Stop 506-316 4800 Oak Grove Drive Pasadena, CA 91103

No. Copies	Addressee	No. Copies	Addressee
1	Cooper Development Association ATTN: Donald K. Miner, Manager 430 N. Woodward Ave Birmingham, MI 48011	1	Billings Energy Corp ATTN: Mr. Hadden P.O. Box 555 Provo, UT 84601
1	Cornell University Joe Rosson, Associate Dir School of Engineering Phillip Hall Ithaca, NY 14853	1	Booz, Allen & Hamilton Inc. John F. Wing Transportation Consulting Div 4330 East West Highway Bethesda, MD 20014
1	Department of Industry, Trade & Commerce Fred Johnson, Special Vehicle Div Transportation Industries Branch Ottawa, Canada, K1A 0S5	1	Borisoff Engineering Co 7726 Burnet Ave Van Nuys, CA 91405
1	Department of Transportation Transportation Systems Ctr ATTN: Dr. Norman Rosenburg Cambridge, MA 02142	3	J. Hampton Barnett Energy Demonstration & Tech 109 United Bank Building Chattanooga, TN 37401
1	Department of Transportation Library, FOB 10.A, TAD-494.6 800 Independence Ave., SW Washington, DC 20591	1	Joel Sanburg Mail Stop 506-316 Jet Propulsion Lab 4800 Oak Grove Dr Pasadena, CA 91103
1	A. D. Little ATTN: Brad Underhill 15 Acorn Park Cambridge, MA 02140	1	Jet Industries Inc. 7101 Burleson Rd Austin, TX 78745
1	Advanced Ground Systems Eng ATTN: Dr. George Gelb 3270 E. 70th Street Long Beach, CA 90805	30	Department of Energy ATTN: Walter Dippold 1000 Independence Ave. Mail Stop 5H044 Room 5H063 Forrestal Bldg Washington, DC 20585
1	Airesearch Manufacturing Co ATTN: Bob Rowlett Program Manager 2525 W. 190th St Torrance, CA 90509	1	International Lead Zinc Research Organization, Inc. 292 Madison Ave New York, NY 10017
1	Argonne National Labs ATTN: Al Chilenskas 9700 South Cass Ave Argonne, IL 60439	1	Bernie Wachter OAO Corp 2101 L Street, NW Washington, DC 20037

No. Copies	Addressee	No. Copies	Addressee
1	C. Joseph Venuto 3043 Walton Rd Plymouth Meeting, PA 19462	5	Batronic Truck Corp Third & Walnut St Boyertown, PA 19512
1	Gary L. Silverman, Manager Systems Application Dept Research Engineering and Research Staff 20000 Rotunda Dr Dearborn, MI 48121	1	Unique Mobility Inc. 3700 S Jason St Englewood, CO 80110
1	Westinghouse R&D Ctr ATTN: G. Frank Pittman, Jr 1310 Beula Rd Pittsburgh, PA 15235	1	Richard H. Auris Philadelphia Elec Co 2301 Market St Post Office Box 8699 Philadelphia, PA 19101
1	Ira L. Davis General Services Admin GSA-TPUS-TMM 425 I St, NW Washington, DC 20406	1	Darryl L. Barnes Arizona Public Service Co 2216 West Peoria Phoenix, AZ 85029
5	Lectra Motors Corp 5380 Valley View Blvd Las Vegas, NV	1	Todd Gerstenberger Northrop Aircraft Div 3901 West Broadway Hawthorne, CA 90250
2	John J. Makulowich Executive Director Electric Vehicle Council 1111-19th St NW Suite 606 Washington, DC 20036	1	Vernon Green U.S. Naval Weapons Ctr Code 2605 China Lake, CA 93555
1	F. J. Liles 705 Buffalo Drive Arlington, TX 76013	1	Jack Hooker Electric Motor Cars 1701 North Greenville Ave Dallas, TX 75081
1	C. Grandy Union Electric Co P.O. Box 149 Saint Louis, MO 63166	1	Henry Hwang University of Hawaii at Manoa Holmes Hall 246 2540 Dole St Honolulu, HI 96822
1	George Marton Matrix Company 3805 Mt Vernon Ave Alexandria, VA 22305	1	Keva Cahill 3521 Norwood Qt Waldorf, MD 20601

No. Copies Addressee

1 Soleq Corp
5969 N. Elston Ave
Chicago, IL 60646

1 Louis Mercatanti
Advanced Vehicle Tech, Inc
20 Nassau St
Princeton, NJ 08540

1 John M. Olsen
Detroit Edison
2000 Second Ave
Detroit, MI 48226

1 Carey V. Rowan
Philadelphia Electric Co
2301 Market St (S10-1)
Post Office Box 8699
Philadelphia, PA 19101

1 George Thiess
Electric Motor Cars
1701 North Greenville Ave
Dallas, TX 75081

1 John Wiegmann
Booz, Allen and Hamilton, Inc.
Transportation Div
4330 East-West Highway
Bethesda, MD 20014

1 Roger Wood
Electric Transportation Systems
850 Bannock St
Denver, CO 80204

1 John Preslein
2740 Mason St
Green Bay, WI 54303

2 Bruce Barnaby
Sandia National Lab
Division 2564
Albuquerque, NM 87185